

REMARKS

Introduction

Applicants note with appreciation the Examiner's indication on page 9 of the Office Action that claims 2-6 and 11-14 would be allowable if rewritten in independent form.

Upon entry of the foregoing amendment, claims 1-18, 20 and 21 are pending in the application. Claims 1, 2, 9, and 10 have been amended. Claim 19 has been previously canceled without prejudice or disclaimer. No new matter is being presented. In view of the following remarks, reconsideration and allowance of all the pending claims are requested.

Entry of this Amendment After Final is proper under 37 C.F.R. §1.116 because the claim amendments: (a) place this application in condition for allowance (for the reasons discussed herein), (b) do not raise any new issues requiring further search and/or consideration (since the amendments amplify issues previously discussed throughout prosecution as indicated in the Final Office Action), (c) present the rejected claims in better form for consideration on appeal (should an appeal be necessary), and (d) are necessary and were not earlier presented because they are made in response to arguments raised in the Final Office Action.

Accordingly, for at least the reasons discussed above, entry of this Amendment is respectfully requested.

Rejection under 35 USC § 101

Claim 9 has been rejected under 35 U.S.C. §101 as not falling within one of the four statutory categories of invention.

In an October 1, 2009 in-person Examiner interview with Applicants' representative, the Examiner stated and made of record in an October 1, 2009 Interview Summary that "amendments to claim 9 to traverse the 35 U.S.C. 101 rejection were no longer necessary due to the new USPTO policy."

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For at least the above reasons, reconsideration of this claim and withdrawal of this rejection are earnestly solicited.

Rejection under 35 USC § 103

Claims 1, 7-9, 15-17, and 18, 20, 21 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Choi et al. "New Frame Rate Up-Conversion Using Bi-Directional Motion Estimation," I.E.E.E. Transactions on Consumer Electronics, Vol. 46, No. 3, (hereinafter, "Choi") in view of Heising et al., "Wavelet-based Very Low Bit Rate Video Coding Using Image Warping and Overlapped Block Motion Compensation" I.E.E.E. Proceedings: Vision, Image and Signal Processing, Vol. 148, No. 2, April 2001, (hereinafter, "Heising"). Reconsideration of these claims in view of the following remarks is earnestly solicited.

Claim 1

Referring to independent claim 1, in the Office Action dated August 20, 2009, the Examiner alleges that Choi and Heising in combination with one another disclose all the limitations recited in independent claim 1. In particular, on page 5 of the Office Action, the Examiner alleges that Choi discloses:

a candidate interpolation pixel calculator to calculate a candidate interpolation pixel by allocating a predetermined weight to the first and the second interpolation pixels (Choi, equation 12 wherein the weight is 0.5).

On pages 5 and 6 of the Office Action, the Examiner acknowledges and Applicants agree that "Choi does not disclose a candidate interpolation pixel calculator to allocate a weight to the first and the second pixels according to relative locations where the first and the second pixels are to be interpolated." On page 6 of the Office Action, the Examiner alleges that Heising discloses:

a candidate interpolation pixel calculator to allocate a weight to the first and second pixels according to relative locations where the first and the second pixels are to be interpolated, and further comprising a motion analyzer, the final interpolation pixel selector selects a final interpolation pixel according to the output result of the motion analyzer (Heising, refer to lines 15 to 21 of the left column, lines 29 to 34 and lines 35 and 36 of the right column in page 95, lines 12 to 18 of the right column in page 99, the first paragraph of the left column in page 100, Figure 2a, and formula 3 and 4).

However, it is respectfully submitted that Choi and Heising, whether taken alone or in combination with one another, fail to teach or suggest all of the features as presently recited in independent claim 1, for at least the following reasons.

Referring to equation 12 on page 606 of Choi as relied upon by the Examiner, Choi describes "construct[ing] the intermediate frame" by "inter-frame interpolation" using "motion vectors." Choi describes and illustrates in FIG. 7 "interpolat[ing] a block *B* in the to-be-interpolated frame," where a "given block *B* with $N \times N$ block size and a small overlapping width *w*" is "extended" to " $(N + 2w) \times (N + 2w)$." Choi describes that the neighboring blocks are also "extended with the same size," and "three distinct overlapping regions *R1*, *R2*, and *R3* ... are generated." Choi describes that the "output of the overlapped block MCI [motion compensated interpolation]" in the "extended block" is "defined according to the number of block overlapping," where equation 12 relates to the overlapping for region *R2* (i.e., where extended block *B* overlaps with blocks *N2*, *N4*, *N5* and *N7* as illustrated in FIG. 7), not a "candidate interpolation pixel calculator" to "calculate a candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels." That is, equation 12 of Choi relates to determining an overlapped block MCI for the extended block *B* according to the block overlapping for region *R2*, where extended block *B* overlaps with blocks *N2*, *N4*, *N5* and *N7* -- not "calculat[ing] a candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels." Applicants submit equation 12 of Choi relates to motion-compensation averaging of a single pixel *p* using the bi-directional motion vector *D* for the extended block region *B* and the overlap region *R2*, not "calculat[ing] a candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels." That is, equation 12 of Choi merely relates to pixel *p*, not "first and the second interpolation pixels."

Referring to page 95, lines 15 to 21 (left column), FIG. 2a, and formula 3 of Heising as relied upon by the Examiner, Heising describes that in "sequences with differently moving objects," warping prediction "is not capable of dealing properly with motion discontinuities at the object borders." In this case of "sequences" with "differently moving objects," Heising describes using "overlapped block motion compensation" in the blocks by "superimposing four predicted intensity values" that use "nonlinear weighting functions." Heising describes that the "four

predicted values" for intensity that are used as "weighting functions" are "computed by employing the translational motion model" with "one of the four vectors" of the "four surrounding vertices for each prediction," and that "one bit is transmitted indicating the used prediction type." In other words, Heising describes using "overlapped block motion compensation" in the blocks for "sequences with differently moving objects," by "superimposing four predicted intensity values" that use "nonlinear weighting functions" – not "calculat[ing] a candidate interpolation pixel" by "allocating a predetermined weight to the first and the second interpolation pixels" according to "relative locations where the first and the second interpolation pixels are interpolated." It is submitted that Heising describes that "intensity values" using "nonlinear weighting functions" are "superimposed" on blocks with "sequences with differently moving objects," not "calculat[ing] a "candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels" according to "relative locations" where the "first and the second interpolation pixels" are "interpolated."

Referring to page 95, lines 29-34 and 35-36 (right column), FIG. 2a, and formula 4 of Heising as relied upon by the Examiner, Heising describes that to "force the estimation of smooth vector fields" a "Langrangian multiplier" is "used to choose the best control point motion vector considering the prediction error" and the "location motion vector variance" between the "candidate vector" and "eight motion vectors" of its "neighboring control points." Heising describes that the "decision whether to use warping prediction or OBMC for a block" is also based on formula 4. In other words, Heising describes that a "Langrangian multiplier" is used to "choose the best control point motion vector" when considering the "prediction error" and the "location motion vector variance" between the "candidate vector" and "eight motion vectors" of its "neighboring control points," not "calculat[ing]" a "candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels" according to "relative locations" where the "first and the second interpolation pixels" are "interpolated." It is submitted that Heising describes "choos[ing] the best control point motion vector," not "calculat[ing]" a "candidate interpolation pixel."

Referring to page 99, lines 12 to 18 (right column) and page 100, first paragraph, of Heising as relied upon by the Examiner, Heising describes a comparison of prediction capabilities of "different motion models" (i.e.: "bilinear warping," "affine warping," "OBMC," and

"BMC" -- "block motion compensation") by using a "Foreman sequence" such that the "last original frame" is used for "motion estimation and compensation." Heising describes that the "bilinear warping model performs best, followed by OBMC, affine warping and BMC." Heising describes that "using the proposed combination of bilinear warping and OMBC" the "prediction can be further improved," whereas "combining OBMC with BMC ... leads to worse predictions." In other words, Heising describes an experiment to compare the prediction capabilities of "bilinear warping," "affine warping," "OBMC," and "BMC" using a "Foreman sequence" such that the "last original frame" is used for "motion estimation and compensation," not "calculat[ing]" a "candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels" according to "relative locations" where the "first and the second interpolation pixels" are "interpolated." At best, Heising describes that the "prediction can be further improved" by combining "bilinear warping and OMBC," not "calculat[ing]" a "candidate interpolation pixel" by "allocating a predetermined weight" to the "first and the second interpolation pixels" according to "relative locations" where the "first and the second interpolation pixels" are "interpolated."

In the October 1, 2009 in-person Examiner interview with Applicants' representative, the Examiner stated and made of record in the October 1, 2009 Interview Summary that if "Applicant clarifi[ed] the term 'result' in claim 1 ... to include comparing a deviation of the motion vector of the current and peripheral block ... [the amended claim] would overcome the prior art of record." Applicant's claim 1 presently recites, among other things, a "final interpolation pixel selector" to "select one among the first interpolation pixel " and a "candidate interpolation pixel" as a "final interpolation pixel" according to the "result determined at the motion analyzer" by "comparing a deviation of the motion vectors" of the "current and the peripheral blocks." Applicant also submits that claim 1 as presently recited is patentably distinguishable over Ohm in combination with Choi and Heising. On page 8 of the Office Action, the Examiner acknowledges and Applicant agrees that "the combination of Choi and Heising does not disclose wherein the motion analyzer compares a deviation of the motion vectors of the current and peripheral blocks." Referring to the "last six sentences of Ohm on the left hand column to the first five sentences of the right hand column" on page 3 of Ohm as relied upon by the Examiner on page 9 of the Office Action, Ohm describes that a "threshold criterion is used which votes for the presence of an object border whenever the distance of two horizontally-adjacent

destination grid points ... lies outside [an] interval." That is, Ohm describes that a presence of an "object border" is determined when the "distance of two horizontally-adjacent destination grid points" is outside an interval, not "select[ing] one among the first interpolation pixel " and a "candidate interpolation pixel" as a "final interpolation pixel" according to the "result determined at the motion analyzer" by "comparing a deviation of the motion vectors" of the "current and the peripheral blocks."

Therefore, Choi and Heising, whether taken alone or in combination with one another, do not teach or suggest, among other things, "a candidate interpolation pixel calculator to calculate a candidate interpolation pixel by allocating a predetermined weight to the first and the second interpolation pixels according to relative locations where the first and the second interpolation pixels are interpolated, among the current blocks to be interpolated" and "a final interpolation pixel selector to select one among the first interpolation pixel and the candidate interpolation pixel as a final interpolation pixel according to the result determined at the motion analyzer by comparing a deviation of the motion vectors of the current and the peripheral blocks, and to output the selected final interpolation pixel" as presently recited in independent claim 1.

Since Choi and Heising, whether taken alone or in combination with one another, do not teach or suggest each of the features as recited in claim 1, claim 1 is patentably distinguishable and deemed to be allowable.

Accordingly, withdrawal of this rejection and allowance of this claim are earnestly solicited.

Claims 7 and 8

With regard to claims 7 and 8, it is requested that for at least the reasons that these claims depend from allowable independent claim 1, and therefore contain each of the features as recited in claim 1, claims 7 and 8 are also patentable over Choi and Heising, whether taken alone or in combination with one another.

Accordingly, withdrawal of these rejections and allowance of these claims are earnestly solicited.

Claim 9

Referring to independent claim 9, in the Office Action dated August 20, 2009, the Examiner alleges that Choi and Heising in combination with one another disclose all the limitations recited in independent claim 9. In particular, on page 5 of the Office Action, the Examiner alleges that Choi discloses:

a candidate interpolation pixel calculator to calculate a candidate interpolation pixel by allocating a predetermined weight to the first and the second interpolation pixels (Choi, equation 12 wherein the weight is 0.5).

On pages 5 and 6 of the Office Action, the Examiner acknowledges and Applicants agree that "Choi does not disclose a candidate interpolation pixel calculator to allocate a weight to the first and the second pixels according to relative locations where the first and the second pixels are to be interpolated." On page 6 of the Office Action, the Examiner alleges that Heising discloses:

a candidate interpolation pixel calculator to allocate a weight to the first and second pixels according to relative locations where the first and the second pixels are to be interpolated, and further comprising a motion analyzer, the final interpolation pixel selector selects a final interpolation pixel according to the output result of the motion analyzer (Heising, refer to lines 15 to 21 of the left column, lines 29 to 34 and lines 35 and 36 of the right column in page 95, lines 12 to 18 of the right column in page 99, the first paragraph of the left column in page 100, Figure 2a, and formula 3 and 4).

However, it is respectfully submitted that Choi and Heising, whether taken alone or in combination with one another, fail to teach or suggest all of the features as presently recited in independent claim 9, for at least the reasons discussed above in connection with claim 1.

Therefore, Choi and Heising, whether taken alone or in combination with one another, fail to teach or suggest, among other things, "calculating a candidate interpolation pixel by allocating a predetermined weight to the first and the second interpolation pixels according to relative locations where the first and the second interpolation pixels are interpolated among the current blocks to be interpolated with a candidate interpolation pixel calculator of a block-based motion compensation apparatus" and "selecting among the first interpolation pixel and the candidate interpolation pixel as a final interpolation pixel according to the result determined in the determining operation of the motion analyzer that compares a deviation of the motion vectors of the current and peripheral block, and then outputting the selected final interpolation pixel with a final interpolation pixel selector" as presently recited in claim 9.

Since Choi and Heising, whether taken alone or in combination with one another, do not teach or suggest each of the features as recited in claim 9, claim 9 is patentably distinguishable and deemed to be allowable.

Accordingly, withdrawal of this rejection and allowance of this claim are earnestly solicited.

Claims 15 and 16

With regard to claims 15 and 16, it is requested that for at least the reasons that these claims depend from allowable independent claim 9, and therefore contain each of the features as recited in claim 9, claims 15 and 16 are also patentable over Choi and Heising, whether taken alone or in combination with one another.

Accordingly, withdrawal of these rejections and allowance of these claims are earnestly solicited.

Claim 17

Referring to independent claim 17, in the Office Action dated August 20, 2009, the Examiner alleges that Choi and Heising in combination with one another disclose all the limitations recited in independent claim 17. In particular, on page 5 of the Office Action, the Examiner alleges that Choi discloses:

a candidate interpolation pixel calculator to calculate a candidate interpolation pixel by allocating a predetermined weight to the first and the second interpolation pixels (Choi, equation 12 wherein the weight is 0.5).

On pages 5 and 6 of the Office Action, the Examiner acknowledges and Applicants agree that "Choi does not disclose a candidate interpolation pixel calculator to allocate a weight to the first and the second pixels according to relative locations where the first and the second pixels are to be interpolated." On page 6 of the Office Action, the Examiner alleges that Heising discloses:

a candidate interpolation pixel calculator to allocate a weight to the first and second pixels according to relative locations where the first and the second pixels are to be interpolated, and further comprising a motion analyzer, the final

interpolation pixel selector selects a final interpolation pixel according to the output result of the motion analyzer (Heising, refer to lines 15 to 21 of the left column, lines 29 to 34 and lines 35 and 36 of the right column in page 95, lines 12 to 18 of the right column in page 99, the first paragraph of the left column in page 100, Figure 2a, and formula 3 and 4).

However, it is respectfully submitted that Choi and Heising, whether taken alone or in combination with one another, fail to teach or suggest all of the features as recited in independent claim 17, for at least the reasons discussed above in connection with claim 1.

Therefore, Choi and Heising, whether taken alone or in combination with one another, fail to teach or suggest, among other things, "calculating a candidate interpolation pixel by allocating a predetermined weight to a first interpolation pixel and a second interpolation pixel according to relative locations where the first and the second interpolation pixels are interpolated among the current blocks to be interpolated" as recited in claim 17.

Since Choi and Heising, whether taken alone or in combination with one another, do not teach or suggest each of the features as recited in claim 17, claim 17 is patentably distinguishable and deemed to be allowable.

Accordingly, withdrawal of this rejection and allowance of this claim are earnestly solicited.

Claims 18, 20, and 21

With regard to claims 18, 20, and 21, it is requested that for at least the reasons that these claims depend from allowable independent claim 17, and therefore contain each of the features as recited in claim 17, claims 18, 20, and 21 are also patentable over Choi and Heising, whether taken alone or in combination with one another.

Accordingly, withdrawal of these rejections and allowance of these claims are earnestly solicited.

Rejection under 35 USC § 103

Claims 2 and 10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Choi and Heising as applied to claim 1, further in view of Ohm, Jens-Ranier, "Motion Grid Interpolation with Simple Contour Adaptation," (hereinafter, "Ohm"). Applicants respectfully traverse these rejections for at least the following reasons.

With regard to claim 2, on pages 2-3 of the Office Action, the Examiner acknowledges and Applicants agree that "Claim 2 contains subject matter which describes the role of the motion analyzer in the motion compensation technique of claim 1, and which was not reasonably taught by the prior art references and therefore objected to." On page 9 of the Office Action, the Examiner states that claim 2 is "objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims." Accordingly, reconsideration of this claim and withdrawal of this rejection are earnestly solicited.

It is requested that for at least the above reasons and that this claim depends from allowable independent claim 1, and therefore contains each of the features as recited in claim 1, that claim 2 is also patentable over Choi, Heising, and Ohm, whether taken alone or in combination with one another.

With regard to claim 10, it is requested that for at least the reason that this claim depends from allowable independent claim 9, and therefore contains each of the features as recited in claim 9, claim 10 is also patentable over Choi and Heising, and Ohm, whether taken alone or in combination with one another.

Accordingly, withdrawal of these rejections and allowance of these claims are earnestly solicited.

Examiner's Response to Arguments

On page 2 of the Office Action, the Examiner states that "Applicant's arguments with respect to claims 1, 9, and 17 have been considered." In the above remarks, Applicants address the Examiner's response to arguments recited on pages 2-3 of the Office Action, as

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well as the rejections recited on pages 3-9 of the Office Action.

Reconsideration of the pending claims in view of the above remarks is earnestly solicited.

Allowable Subject Matter

On page 9 of the Office Action, the Examiner states that "Claims 2-6 and corresponding claims 11-14 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims." The Examiner further states that "[r]egarding claims 3-6 and corresponding claims 11-14, none of the references of record alone or in combination suggest or fairly teach the limitations contained therein."

With regard to claims 2-6 and 11-14, Applicants respectfully submit that since these claims depend from allowable independent claims 1 and 9, respectively, and therefore contain each of the features as recited in claims 1 and 9, respectively, claims 2-6 and 11-14 are also allowable.

Accordingly, withdrawal of these objections and allowance of these claims are earnestly solicited.

Conclusion

It is respectfully submitted that a full and complete response has been made to the outstanding Office Action and, as such, there being no other objections or rejections, this application is in condition for allowance, and a notice to this effect is earnestly solicited.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided below.

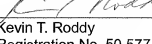
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If any further fees are required in connection with the filing of this amendment, please charge the same to our Deposit Account No. 502827.

Respectfully submitted,

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